MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

TAI2151 – ARTIFICIAL INTELLIGENCE FUNDAMENTALS

(All Sections/Groups)

24 October 2018
2.30pm – 4.30pm
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **5** pages with **5** questions only.
2. Attempt **ALL FIVE** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the answer booklet provided.

Question 1

(a) What are weak AI and strong AI? (2 marks)

(b) Answer with justification the chess with a clock task environment according to the following properties:
(i) Is it fully or partially observable? (1 mark)
(ii) Is it deterministic or stochastic? (1 mark)
(iii) Is it episodic or sequential? (1 mark)
(iv) Is it static, dynamic or semi-dynamic? (1 mark)
(v) Is it discrete or continuous? (1 mark)

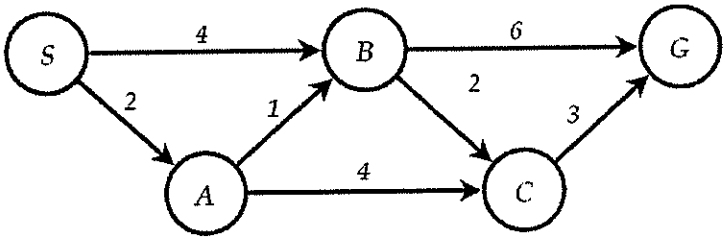
(c) Answer the following questions about a simple reflex agent:
(i) Give an example of a simple reflex agent. (1 mark)
(ii) Give an advantage of a simple reflex agent. (1 mark)
(iii) Give a disadvantage of a simple reflex agent. (1 mark)

Question 2

(a) What is an admissible heuristic function? (2 marks)

(b) Why the straight-line distance for each node in a graph to the goal node is an admissible heuristic function? (2 marks)

(c) The graph below represents a problem space. **S** is the start node and **G** is the goal node. To the right, three different heuristic functions, $\mathbf{h_1}$, $\mathbf{h_2}$ and $\mathbf{h_3}$, are defined in a table.



	h_1	h_2	h_3
S	8	7	3
A	3	4	0
B	7	5	4
C	2	2	3
G	0	0	0

(i) Which of the heuristics, $\mathbf{h_1}$, $\mathbf{h_2}$ and $\mathbf{h_3}$, are admissible? (2 marks)

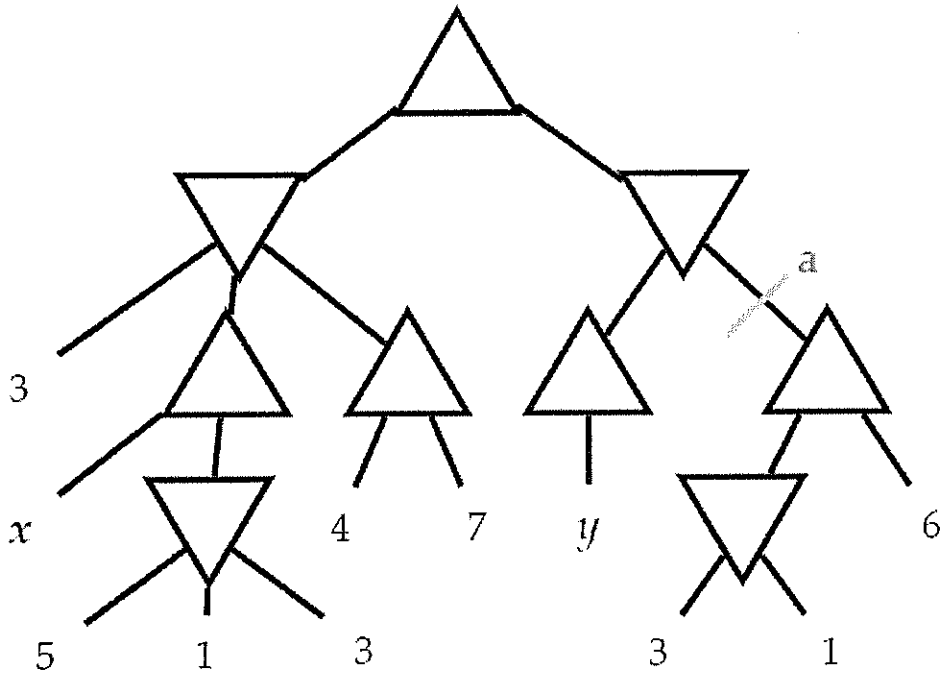
(ii) What is the final solution path found by using Greedy Search using $\mathbf{h_3}$ heuristics? What is the path cost? (2 marks)

(iii) What is the final solution path found by using A* Search using $\mathbf{h_3}$ heuristics? What is the path cost? (2 marks)

Continued....

Question 3

In the following minimax game tree, △ are maximising nodes, and ▽ are minimising nodes. Note that there are two unspecified leaves nodes, which are marked as **x** and **y**.



(a) Assuming that **y** = 0, for which values of **x** will the minimax value of the topmost node be **x**? Give the reason for your answer. (3 marks)

(b) Assuming that **x** = 0, for which values of **y** will the minimax value of the topmost node be **y**? Give the reason for your answer. (3 marks)

(c) For which values of **x** and **y** will minimax with α-β pruning not consider branch **a**? (In other words: For which values of **x** and **y** will branch **a** be pruned away?) (4 marks)

Continued....

Question 4

You are given the following predicates:

cat(X) = *X* is a cat
mammal(X) = *X* is a mammal
intelligent(X) = *X* is intelligent

(a) Translate the following English sentences into First-Order Logic statements:
1. Garfield is a cat.
2. All cats are mammal.
3. All mammals are intelligent. (2 marks)

(b) Convert the First-Order Logic statements obtained in (a) into Conjunctive Normal Form. (2 marks)

(c) Use resolution refutation to prove that Garfield is intelligent. (6 marks)

Continued....

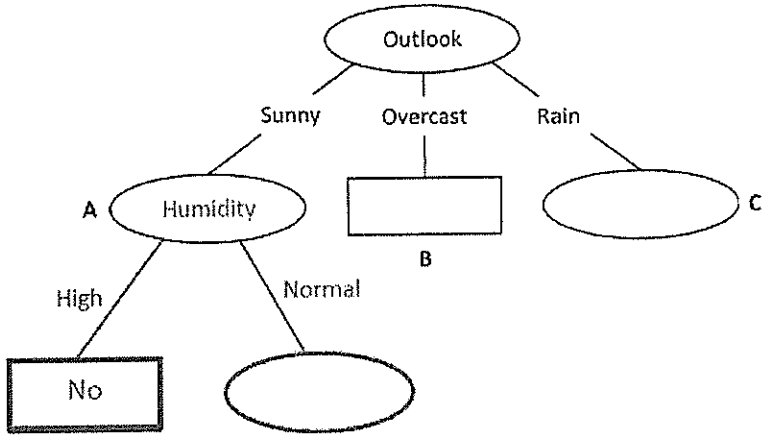
Question 5

Consider the following Play Tennis dataset:

Attributes:	Possible Values:
Outlook	{Sunny, Rain, Overcast}
Temperature	{Hot, Mild, Cool}
Humidity	{High, Normal}
Wind	{Strong, Weak}
PlayTennis (target/goal/class attribute)	{Yes, No}

ID	Outlook	Temperature	Humidity	Wind	PlayTennis
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Sunny	Hot	Normal	Weak	Yes
4	Sunny	Mild	Normal	Strong	Yes
5	Sunny	Mild	Normal	Weak	No
6	Rain	Mild	High	Strong	No
7	Rain	Mild	Normal	Weak	Yes
8	Rain	Cool	Normal	Weak	Yes
9	Rain	Mild	Normal	Strong	Yes
10	Rain	Cool	Normal	Strong	No
11	Overcast	Hot	High	Weak	Yes
12	Overcast	Cool	High	Strong	Yes
13	Overcast	Mild	High	Strong	Yes
14	Overcast	Hot	Normal	Weak	Yes

The machine learning task is to predict whether to play tennis or not, based on the data about the weather. Suppose we are in the middle of inducing the decision tree. The current state of the decision tree is given below:



(a) What should the tree output be in the leaf box labelled **B**? Explain. (2 marks)

Continued....

(b) Which data instances/records should be considered in node **A**? Write down the relevant instance ID numbers from the table. (2 marks)

(c) Calculate the entropy at node **A** for the **Humidity** attribute. Show all the steps of your calculation. For your convenience the logarithm in base 2 of selected values are given in the following table. (4 marks)

x	1/2	1/3	2/3	1/4	3/4	1
$\log_2(x)$	-1	-1.6	-0.6	-2	-0.4	0

(d) We have already calculated the entropies of **Temperature** and **Wind** at node **A**, and they are both 0.96. Based on these values, and based on the result you obtained in (c) above, which attribute should be used to split node **A**? (2 marks)

End of Paper